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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/805,027	03/12/2001	Lloyd G. Burrell	FIS920000242US1	1563
30743	7590	04/20/2005	EXAMINER	
WHITHAM, CURTIS & CHRISTOFFERSON, P.C.			LEWIS, MONICA	
11491 SUNSET HILLS ROAD			ART UNIT	
SUITE 340			PAPER NUMBER	
RESTON, VA 20190			2822	

DATE MAILED: 04/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

Office Action Summary	Application No. 09/805,027	Applicant(s) BURRELL ET AL.	
	Examiner Monica Lewis	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 December 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-7,9 and 10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5-7,9 and 10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 March 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This office action is in response to the amendment filed December 10, 2004.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3 and 5-7 are rejected under 35 U.S.C. 103(a) as obvious over Colgan et al. (U.S. Patent No. 5,565,707) in view of Shue et al. (U.S. Patent No. 6,531,389) and Uzoh (U.S. Patent No. 5,930,669).

In regards to claim 1, Colgan et al. ("Colgan") discloses the following:

- a) a patterned aluminum layer (30) (For Example: See Figure 1);
- b) a patterned copper layer (40) (For Example: See Figure 1); and
- c) an opening (36) in a layer of material, said opening extending between a location on said patterned copper layer and a location on said patterned aluminum layer (For Example: See Figure 1); and
- d) stud connection being formed of tungsten (For Example: See Column 1 Lines 15-20 and Column 2 Lines 65 and 66).

In regards to claim 1, Colgan fails to disclose the following:

- a) a multi-layer barrier liner where at least the first layer being of a material which is conductive and has adhesion to copper and tungsten comparable to that of tantalum or tantalum nitride or titanium nitride and resists interdiffusion of copper and tungsten and a second layer being of a material on which tungsten can be deposited, one or both first and second layers forming a conductive barrier to process materials are reactive to copper.

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However, Uzoh discloses a liner that can be comprised of multiple layers of materials such as tantalum, tantalum nitride, titanium nitride and tungsten (For Example: See Column 4 Lines 20-35). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a liner comprising layer of tantalum, tantalum nitride, titanium nitride and tungsten as disclosed in Uzoh because it aids in providing superior electromigration (For Example: See Column 2 Lines 40-55) (Note: Although Uzoh does not specifically disclose that the first layer has adhesion to copper and tungsten comparable to that of tantalum or tantalum nitride or titanium nitride and resists interdiffusion of copper and tungsten and a second layer being of a material on which tungsten can be deposited, one or both first and second layers forming a conductive barrier to process materials are reactive to copper, the same materials are utilized in Uzoh as in Applicant's invention therefore it would have the same characteristics).

Additionally, since Colgan and Uzoh are both from the same field of endeavor, the purpose disclosed by Uzoh would have been recognized in the pertinent art of Colgan.

b) a liner in said opening and having a thickness extending between said stud connection and said location on said copper layer at said location on said patterned copper layer.

However, Shue et al. ("Shue") discloses a liner having a thickness extending between said stud (30a) and copper layer (12) (For Example: See Figure 6). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a liner having a thickness extending between said stud and copper layer as disclosed in Shue because it aids in reducing parasitic capacitance (For Example: See Column 1 Lines 15-67 and Column 2 Lines 1-49).

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Additionally, since Colgan and Shue are both from the same field of endeavor, the purpose disclosed by Shue would have been recognized in the pertinent art of Colgan.

Finally, the following limitation makes it a product by process claim: a) "assists in the formation of a stud during deposition;" and b) "forming a conductive barrier to process material which are reactive to copper." The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "product by, all of" claim, and not the patentability of the process, and that an old or obvious product, whether claimed in "product by process" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.

In regards to claim 2, Colgan fails to disclose the following:

a) a layer of tantalum nitride, and a layer of PVD tungsten.

However, Uzoh discloses a liner comprising a layer of tantalum nitride, and a layer of tungsten (For Example: See Column 4 Lines 20-35). It would have been obvious to one having

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ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a liner comprising layer of tantalum nitride, and a layer of tungsten as disclosed in Uzoh because it aids in providing superior electromigration (For Example: See Column 2 Lines 40-55).

Additionally, since Colgan and Uzoh are both from the same field of endeavor, the purpose disclosed by Uzoh would have been recognized in the pertinent art of Colgan.

Finally, the following limitation makes it a product by process claim: a) "PVD tungsten." The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "*product by process*" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "*product by, all of*" claim, and not the patentability of the process, and that an old or obvious product, whether claimed in "*product by process*" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.

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In regards to claim 3, Colgan fails to disclose the following:

- a) a layer of tantalum nitride, a layer of titanium nitride and PVD tungsten.

However, Uzoh discloses a liner comprising a layer of tantalum nitride, a layer of titanium nitride and tungsten (For Example: See Column 4 Lines 20-35). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a liner comprising a layer of tantalum nitride, a layer of titanium nitride and tungsten as disclosed in Uzoh because it aids in providing superior electromigration (For Example: See Column 2 Lines 40-55).

Additionally, since Colgan and Uzoh are both from the same field of endeavor, the purpose disclosed by Uzoh would have been recognized in the pertinent art of Colgan.

Finally, the following limitation makes it a product by process claim: a) "PVD tungsten." The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "*product by process*" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "*product by, all of*" claim, and

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not the patentability of the process, and that an old or obvious product, whether claimed in "*product by process*" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.

In regards to claim 5, Colgan discloses the following:

a) a patterned aluminum layer includes a layer of at least one of titanium, and titanium nitride (For Example: See Column 5 Lines 23-27).

In regards to claim 6, Colgan discloses the following:

a) a patterned aluminum layer includes a layer of at least one of titanium, and titanium nitride (For Example: See Column 5 Lines 23-27).

In regards to claim 7, Colgan discloses the following:

a) a patterned aluminum layer includes a layer of at least one of titanium, and titanium nitride (For Example: See Column 5 Lines 23-27).

4. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as obvious over Colgan et al. (U.S. Patent No. 5,565,707) in view of Shue et al. (U.S. Patent No. 6,531,389), Uzoh (U.S. Patent No. 5,930,669) and Jain (U.S. Patent No. 5,933,758).

In regards to claim 9, Colgan fails to disclose the following:

a) a covering layer.

However, Jain discloses a covering layer (50) (For Example: See Column 5 Lines 25-28). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a covering layer as disclosed in Jain because it aids in increasing component density (For Example: See Figure 5).

Additionally, since Colgan and Jain are both from the same field of endeavor, the purpose disclosed by Jain would have been recognized in the pertinent art of Colgan.

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In regards to claim 10, Colgan fails to disclose the following:

a) a covering layer includes a layer of silane based high density plasma oxide.

However, Jain discloses a covering layer (For Example: See Column 5 Lines 25-28). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Colgan to include a covering layer as disclosed in Jain because it aids in increasing component density (For Example: See Figure 5).

Additionally, since Colgan and Jain are both from the same field of endeavor, the purpose disclosed by Jain would have been recognized in the pertinent art of Colgan.

Finally, the following limitation makes it a product by process claim: a) "silane based high density plasma oxide." The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "product by, all of" claim, and not the patentability of the process, and that an old or obvious product, whether claimed in

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"*product by process*" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.

Response to Arguments

5. Applicant's arguments filed 12/10/04 have been fully considered but they are not persuasive. First, Applicant argues that "Colgan et al. does not recognize the problem of corrosion of copper by process material when forming a tungsten stud for connection between copper and aluminum wiring layers...Colgan et al. addresses the problem of metal migration...interposition of any type of barrier in or use of an interconnect material of another material would prevent operation of Colgan et al. in the intended manner and hence, any modification of Colgan et al. which would include provision of such a barrier (including the barrier 28a or stud layer 30a of Shue et al.) would be improper." In response to applicant's argument, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Second, Applicant argues that "while Uzoh may teach claimed material, it does not teach or suggest a barrier layer as a via liner which will resist attack of copper by process material during formation of a via between a copper layer and an aluminum layer...Uzoh is concerned with developing a single crystalline conductor material extending through the structure and does so by utilizing an open bottomed via liner structure...any modification of any barrier layer or closure of the bottom of the trench would preclude operation of Uzoh in the manner intended." However, Uzoh discloses that the liner (20 and 30) is a continuous liner covering sidewalls and

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the bottom of the trench (13) (For Example: See Column 4 Lines 20-28). Although Uzoh fails to specifically disclose "one or both of said first and second layers forming a conductive barrier to process materials which are reactive with copper," the same materials are utilized in Uzoh as in Applicant's invention therefore it would have the same characteristics.

Third, Applicant argues that "Shue et al., even if (arguendo) properly combinable with Colgan et al. or Uzoh does not address the problems of attack of copper by process materials, small via size or reducing the number of requires aluminum layers or provide the solution claimed, particularly since tungsten is disclosed as a suitable barrier material and thus Shue et al. does not and cannot provide evidence of a level of ordinary skill in the art." In response to applicant's argument, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica Lewis whose telephone number is 571-272-1838.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722 for regular and after final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

ML
April 15, 2005



Mary Wilczewski
Primary Examiner